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WATER QUALITY CONTROL STUDY AND PUBLIC HEALTH ASPECTS OF THE BATTLEMENT MESA PROJECT

Public Health Service
Denver, Colorado

June 1965

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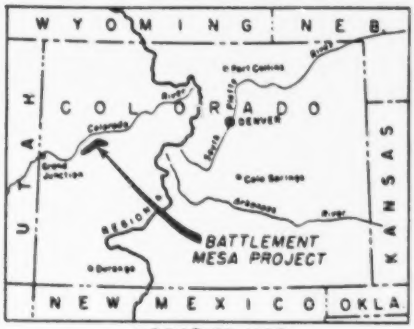

LOCATION MAP

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
DIVISION OF WATER SUPPLY AND POLLUTION CONTROL
REGION VIII
DENVER, COLORADO

June 1965

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WATER QUALITY CONTROL STUDY
and
PUBLIC HEALTH ASPECTS
of the
BATTLEMENT MESA PROJECT

ABSTRACT

A survey has been made of the Battlement Mesa Project which discloses that there is no apparent need for storage for streamflow regulation for the purpose of water quality control. This conclusion is based on results of economic and demographic studies which indicate that future waste loadings will not impair water quality for present and projected water users in the area.

Prepared at the request of and in cooperation with the Bureau of Reclamation, Region 4, U. S. Department of the Interior, Salt Lake City, Utah

U. S. Department of Health, Education, and Welfare
Public Health Service
Division of Water Supply and Pollution Control
Region VIII
Denver, Colorado

June 1965

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INTRODUCTION

Request and Authority

The Bureau of Reclamation, Region 4, Department of the Interior, in a letter dated August 14, 1962, requested the Public Health Service, Department of Health, Education, and Welfare, to participate in the water quality control aspects of the Bureau's planning for the Battlement Mesa Project as set forth in the Federal Water Pollution Control Act, as amended (33 U.S.C. 466 et seq). Further, it was requested that consideration be given to the general public health aspects of the Bureau of Reclamation's Battlement Mesa Project in accordance with a memorandum of understanding dated September 28, 1956, between Region 4 of the Bureau of Reclamation and the Public Health Service.

Purpose and Scope

General objectives of this study are to assess the probable effects of the proposed project on water quality in local streams and reservoirs; to ascertain the benefits or harm resulting from changes in water quality; to assess the suitability of the water for proposed water uses; and to determine the need for and value of storage for regulation of streamflow for the purpose of water quality control. The study covers Mesa County in west central Colorado. The need for streamflow regulation was studied not only for the present conditions, but also for anticipated future conditions in the years 1980, 2000, 2030, and 2060.

Since this study has been made in advance of any comprehensive study of the Colorado River Basin, the findings presented are preliminary and subject to revision upon completion of comprehensive studies for water supply and water quality management in the Colorado River Basin.

The report includes the results of a study of general public health aspects and insect vector control of the project. The insect vector control section, prepared jointly by the Colorado State Department of Public Health and the Communicable Disease Center, Public Health Service, Greeley, Colorado, presents a preliminary evaluation of the insect vector problems that may be associated with the project.

Acknowledgments

The assistance and cooperation of many State and Federal agencies and individuals are gratefully acknowledged by the Public Health

Service. Particular appreciation is expressed to the following for data and advice furnished by their staff members:

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Denver, Colorado 80220

Fish & Wildlife Service
Bureau of Sport Fisheries & Wildlife
Salt Lake City, Utah

U. S. Department of Agriculture
River Basin Survey Field Party
12015 Federal Office Building
20th & Stout Streets
Denver, Colorado 80202

PART A

WATER QUALITY CONTROL STUDY

I. SUMMARY OF FINDINGS AND CONCLUSIONS

Summary of Findings

1. The Battlement Mesa Project is located in west central Colorado near Grand Junction in Mesa County. The project consists of a reservoir and canal system which will impound the spring runoff from snowmelts and regulate this water for irrigation of project lands.

2. The raising of cattle is the basic source of livelihood for the 1,569 people who live in the Plateau Creek Basin. This activity provides less economic return to the area than found in the State as a whole. Catering to outdoor recreationists, particularly hunters and fishermen, is an important secondary occupation.

3. Water originating in the highlands will be collected upstream in Owens Reservoir and further downstream in Buzzard Creek Reservoir. The total dissolved solids (TDS) concentration in the two impoundments will average 110 and 175 milligrams per liter (mg/l), respectively.

4. Domestic waste, at present, is being treated such that no pollution problem results. No mineral springs or poor quality irrigation returns were found in the project area.

Conclusions

1. The proximity of the area to Grand Junction and the prospective site of development of a shale oil industry holds promise of future growth as an overflow from activities in these adjacent areas. The population is expected to double in the next 35 years to 3,200 in the year 2,000 and more than redouble to 7,500 in 2060.

2. Under project condition 14 tons/day of TDS will be added to surface waters. The TDS concentration in Plateau Creek below the irrigation lands will increase 31 mg/l or 11 percent. This same load will increase the TDS concentration in the Colorado River by less than 1 mg/l. There are no users of Plateau Creek water who will be adversely affected by this increase.

3. Both the present minimum streamflows and the anticipated return flows below this project will not impair the beneficial uses of Plateau Creek.

4. Under present and anticipated conditions, there is no need for storage in the Battlement Mesa Project reservoirs for streamflow regulation for the purpose of water quality control.

5. There is the possibility that a need for regulation of streamflow for the purpose of water quality control will become apparent when comprehensive studies of the Colorado River Basin have been completed. These studies should establish the magnitude of the cumulative effect on water quality of the many projects being planned and constructed by the Bureau of Reclamation and others, or the possible cumulative improvement in the quality of the Colorado River which might be derived from the integrated operation of storage provided for flow regulation in all of these reservoirs. Until such studies have provided more definitive data, however, recommendations cannot be made.

II. PROJECT DESCRIPTION

The structural features of the proposed project are shown on the fold-out map (Figure 1) at the end of the report. A description of these features is as follows:*

1. Owens Reservoir will be located at the confluence of Owens and Buzzard Creeks. The reservoir will have a capacity of 25,250 acre-feet (AF) and will impound water from 52.2 square miles of watershed area.

2. Buzzard Creek Dam and Reservoir will be located on Buzzard Creek, six miles upstream from Collbran. This reservoir will have an active capacity of 10,800 AF and will collect stream accretions and irrigation returns to Buzzard Creek below Owens Reservoir and releases from the Owens Reservoir. Also some winter flows will be diverted from Brush Creek through existing ditches into Buzzard Creek Reservoir.

3. The Harrison Canal, which will originate at Owens ~~Creek~~ Reservoir, will have an initial capacity of 55 cfs and a length of 12.0 miles. This canal will service the lands which are south of Buzzard Creek but upstream from Buzzard Creek Reservoir.

4. Brush Creek Canal with an initial capacity of 30 cfs and a length of 11.9 miles also will originate on Buzzard Creek about 7 miles below Owens Reservoir. It will serve lands north of Buzzard Creek and terminate at Brush Creek.

5. Colorado Canal will originate on Buzzard Creek one and a half miles below the Buzzard Creek Reservoir. The canal will have an initial capacity of 105 cfs and a length of 16.6 miles. It will service lands north of Plateau Creek to a point two miles west of Jerry Gulch.

6. Cheney Canal with a capacity of 30 cfs and a length of 14.6 miles will commence at Owens Reservoir and deliver water to lands near Road Gulch.

7. Tanner Siphon will be 2.5 miles long and will carry 35 cfs across a dish-shaped area near the end of the Colorado Canal.

*Information provided by the Bureau of Reclamation

Surplus winter and high spring runoffs will be captured in the two reservoirs. Release of this water will be regulated according to irrigation requirements in late summer when streamflows are inadequate. The proposed project will provide supplemental water to 3,130 acres and full service water, i.e., water for new lands, to 6,340 acres of agricultural lands. The irrigated lands of the project lie north of Plateau Creek starting eight miles below Collbran near Jerry Gulch, and extending fifteen miles upstream from Collbran. Several acres of irrigated land south of Buzzard Creek but above Buzzard Creek Reservoir are also included. The topography of the valley will limit collection and reuse of irrigation returns to the area which lies above the Buzzard Creek Reservoir.

III. AREA DESCRIPTION

The Battlement Mesa Project is located in west central Colorado 40 miles northeast of Grand Junction. The town of Collbran, population 310, which is the main population center for the project area, is near the center of the existing and proposed irrigated lands. (See Figure 1) This town is 23 miles upstream from the mouth of Plateau Creek which discharges into the Colorado River 25 miles upstream from Grand Junction. Plateau City, population 60, and the Collbran Job Corps Camp, population 100, are located a few miles downstream from Collbran. Molina, population 150, is the only other town in the Plateau Creek Basin; however, it is not in the project area. Plateau Creek Basin itself lies within Mesa County.

State Route 330 is the only year-around transportation route to this area. This route parallels Plateau Creek and joins U. S. Routes 24 and 6 at the mouth of Plateau Creek. Proceeding upstream from the Colorado River, Plateau Creek flows through a narrow canyon, often less than 100 yards wide, which opens into a valley with a gentle sloping terrain. The agricultural activity and the center of population in Plateau Creek Basin lie at the end of this canyon between 20 and 40 miles upstream from the Colorado River. The area above the agricultural lands is primarily forest covered mountains. Outcroppings of Wasatch shale are in evidence in the lower agricultural area.

The Collbran Project, a Bureau of Reclamation project now in operation, is adjacent to the proposed Battlement Mesa Project and lies south of Plateau Creek. The main storage for this project is Vega Reservoir which impounds flows of Plateau Creek.

The elevation of the proposed lands to be irrigated near Collbran is approximately 6,000 feet while the upper lands on Buzzard Creek, upstream of Buzzard Creek Reservoir, range in elevation from 7,200 feet to 8,000 feet. The watershed for Owens Reservoir ranges in elevation from 8,300 feet to peaks above 11,000 feet, whereas the watershed for Buzzard Creek Reservoir extends down to 7,200 feet.

Precipitation recorded at Collbran gives a 30 year average of 18.37 inches a year. The average growing season on the lower lands is 158 days and on the upper lands it is 117 days. The frost free period of the lower irrigated lands is 124 days whereas for the upper irrigated lands the frost free period is 99 days.

IV. WATER RESOURCES OF THE STUDY AREA

Water Supplies

Collbran is the only community in the Plateau Creek Basin which has municipally supplied water. The city recently abandoned their former water supply for a more suitable water. The new water is pumped from infiltration wells on Buzzard Creek 10 miles upstream from Collbran. The communities of Molina, Plateau City, and the Job Corps Camp, as well as rural users, receive their domestic water from private wells or springs.

Water Quality

Chemical quality data from Collbran's current source of water is limited to two electrical conductivity readings taken in January and February 1965. These readings when converted to TDS by means of the graph in Appendix A, were 420 and 430, respectively. Data on the quality of groundwater used for domestic purposes are limited.

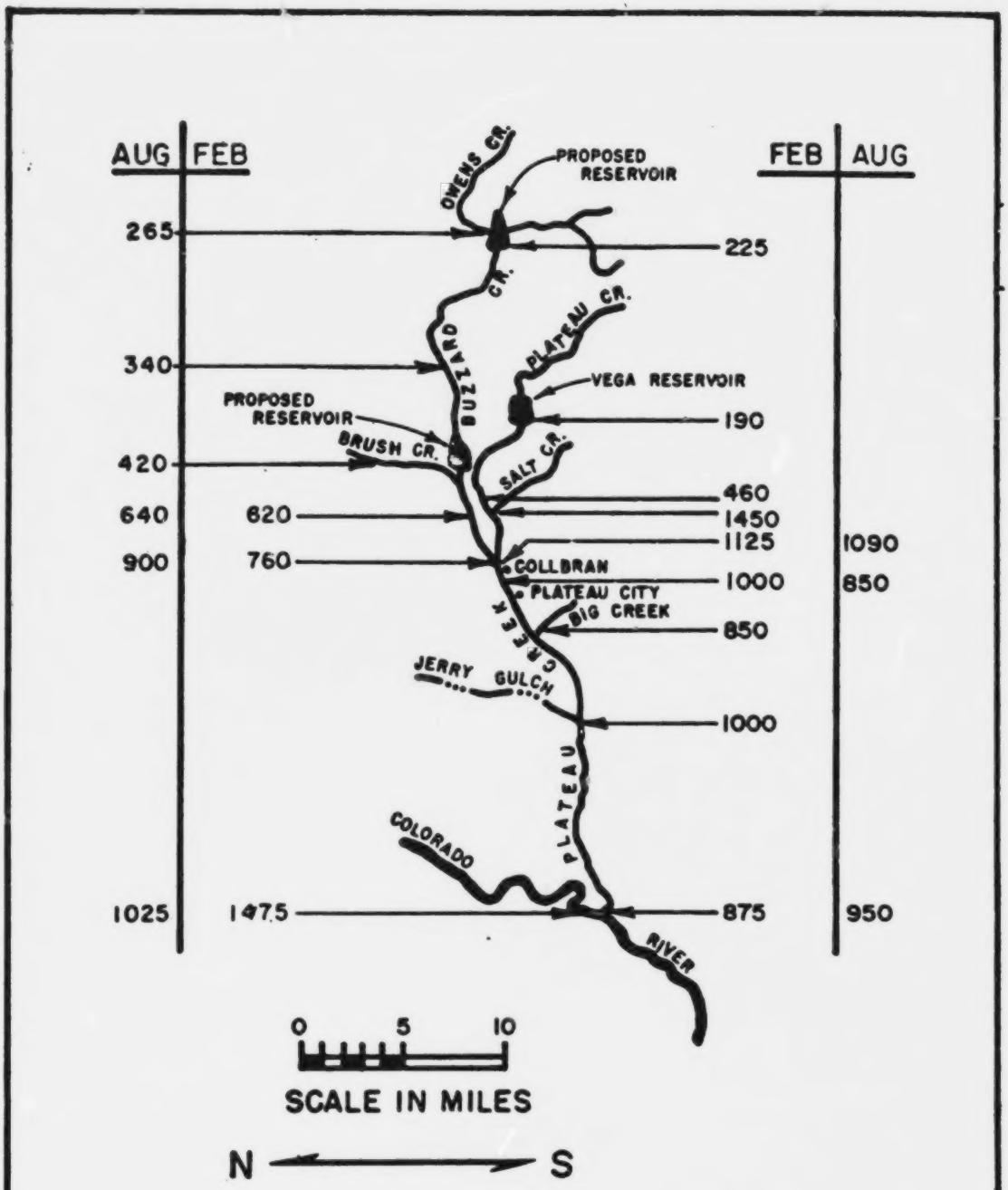
The impounded water in Owens Reservoir will consist of groundwater and spring snowmelts having a TDS concentration of approximately 110 mg/l. Buzzard Creek Reservoir will collect nearly the same type of runoff but will have a TDS concentration of approximately 175 mg/l. The total dissolved solids measurement is used in this report as a measure of water quality since other water quality parameters such as bicarbonates, carbonates, sulfates, sodium, calcium, and magnesium do not contribute any additional pertinent information.

The sodium adsorption ratio is a water quality parameter of primary importance in determining the suitability of water for irrigation. The impounded water in both reservoirs has sodium adsorption ratios well below the tolerance limits of the most sensitive crops.

Table I is a compilation of flow and TDS data for the U. S. Geological Survey gaging stations in the Battlement Mesa area (see Figure 1 for location of these stations). The maximum and minimum flow and TDS concentrations are given along with the average flow and the flow weighted means of the TDS concentration.

Figure 2 depicts the normal deterioration in mineral quality, that is, low mineral pollution in the upper tributaries of Plateau and Buzzard Creeks and a gradual but definite increase in mineral pollution as the water moves downstream. This figure displays specific conductance (Ec) readings as they were found on a February and an August field trip to the valley. For a comparison of Ec vs. TDS for

this area see the graph in Appendix A. These readings are only grab samples, but they do give a relative view of the varying stream quality for the basin. This degradation in water quality is confirmed by the TDS data listed in Table I which was collected over a longer period of time.



Specific conductance at 25°C, μ NHOS/CM

WATER QUALITY CONTROL STUDY PLATEAU CREEK BASIN
CONDUCTIVITIES OF SURFACE WATERS FOR AUGUST 1964 AND FEBRUARY 1965
DEPT. OF HEALTH, EDUCATION & WELFARE Public Health Service REGION VIII DENVER, COLO

FIGURE 2

TABLE I

TOTAL DISSOLVED SOLIDS CONCENTRATION
FOR STREAMS IN THE BATTLEMENT MESA AREA***

Sample Location*	Sampling Period	Number of Samples	Mean Total Dissolved Solids-mg/l	TDS Max./Min. (mg/l)**	Mean Flow cfs	Flow Max./Min. (cfs)**
Plateau Creek near USGS Station at Cameo	4-15-60 9-9-64	49	284.6	570 127	140.3	885 20
Buzzard Creek at USGS Station near Collbran	11-5-62 8-10-64	18	172.6	396 135	24.7	84 0.1
Brush Creek at USGS Station near Collbran	5-4-63 6-10-64	5	182.2	280 167	6.7	19 0.3
Buzzard Creek at USGS Station below Owens Creek	11-5-62 8-10-64	15	109.3	214 74	16.1	83 .5

* See Figure 1
** Upper number represents high extreme and lower number represents low extreme of this data
***Data received from Bureau of Reclamation

V. THE ECONOMY

The area encompassed by this study is small. This is a striking feature, not only in terms of the population of only 1569 people, and the relatively small surface area of 450 square miles, but more so because it is physically and dramatically isolated geographically by Battlement Mesa. This Mesa separates the area from the Colorado River Valley to the north and west, and the Grand Mesa, a relatively primitive area, separates the study area on the south and east. The area can be entered only by means of the narrow defile through which Plateau Creek flows to its confluence with the Colorado River, or via an unimproved road over the mountainous divide that delineates the Plateau Creek Basin. This enclave is located in Mesa County in the extreme western part of Colorado.

The area is entirely rural in character. The largest town is Collbran with 310 inhabitants, which is about 20 percent of the area's 1960 population. There are in addition three small villages, Mesa, Molina, and Plateau City.

Although most of the data presented in this study is for the Plateau Creek Basin, which entirely embraces the project under consideration, much of the economic functioning of the area has its roots or flowering outside the basin in Mesa County and the western slope Colorado economy of which it is a part. A more accurate understanding of the economy, then, requires some consideration of these areas, and some of the data presented in later tables and figures will include this larger area within which the area of most immediate interest functions. The greater part of future economic growth in this small area is expected to derive from activities outside the Plateau Creek Basin.

Present Economic Activity

Agriculture is the heart and substance of the economy of the area with recreation of considerable and growing importance. The following tables outline the use and ownership of land within the Plateau Creek Basin.

Land use - Plateau Creek Basin

	Acres	Percent of Total
Total Land Area	384,640	100
Irrigated	29,100	7.6
Dry farmed	960	0.3
Range livestock grazing	268,660	69.8
Privately owned 103,540		
Federally owned 165,120		
Timber & grazing	79,200	20.6
Privately owned 7,800		
Federally owned 71,400		
Developed recreation use	3,880	1.0
Privately owned 2,100		
Federally owned 1,780		

Landownership - Plateau Creek Basin

U. S. Forest Service	49.1%
U. S. Bureau of Land Management	13.1
State and Local Government	0.5
Private Ownership	37.3
	100.0%

It is apparent that land under public management are an important factor in the economy of the area.

There were 210 farms operating here in 1959, 82 fewer than a decade earlier. All but nine of these have some irrigated land which is generally steep and rolling with rather shallow soils. During the years 1943-60 an average of 46 percent of this irrigated land was used to grow hay, 48 percent was in irrigated pasture, 3 percent in small grain and 2 percent in corn.

The average size of farms has increased from 456 acres to 799 acres, while the value of land and buildings per farm grew from $10,747 to $24,698. The value of farm products grew from $1,746,879 in 1949 to $2,356,674 in 1959 of which 63 percent was from sale of livestock and livestock products, and nearly 12 percent from sale of dairy products.

As the foregoing table illustrates, range livestock grazing is the ascendant agricultural activity. Both public and private lands are used for grazing. In 1960, the subbasin saw a total of 62,932 animal unit months (AUM) of grazing on private lands, more than half of this

on irrigated pasture. This was supplemented by 29,234 AUM grazing on forest lands (by 83 permittees) and 4,719 AUM is on Bureau of Land Management lands (by 37 permittees).

The total income from farm products sold in the subbasin in 1959 was $2,356,674 or $10,880 per farm or ranch. By comparison, the product per farm for all of Mesa County was $12,199 and the comparable figure for the state was $22,183 and for the most productive agricultural county in the state, $38,000. Deducting the cash expenditures leaves the average Mesa County farmer with $7,634 as return for this labor and his investment in land and equipment, which is just about 75 percent of the state average. Although these figures are only approximations, they do give an indication of a relatively lower level of agricultural prosperity in the study area.

Outdoor Recreation is currently an important source of income to the economy of the area and gives promise of becoming even more important in the future. Grand Mesa National Forest which comprises the southern portion of the subbasin is widely known as an attractive recreational area. This national forest had an estimated 197,000 visitor days of recreational use in 1962, including fishermen, hunters, skiers and general sightseers and picnickers. Fifty-eight thousand six hundred of these visitor days were to Vega Reservoir built by an earlier reclamation project (the Collbran Project). At the present rate of increase in demand for recreation, the number of visitor days is expected to increase to nearly a million in the next 35 years.

At the present time there are about 15 ranches which take in hunters during the hunting season, averaging 10-15 hunters each annually. They charge around $250 a week for elk hunters and $20 a day for deer hunters. In addition, there are three or four full time guide services (with a total of about 11 guides) catering to hunters and fishermen. In 1962, 4,500 hunters, two-thirds of them Colorado residents, took 5,747 deer, 126 elk and 19 bears out of the area, generating a total expenditure of $912,465 within the state of Colorado, of which approximately 40 percent was spent for clothing and equipment and 60 percent was spent for meals, lodging, travel, entertainment, etc.

There are also three private fishing ponds and two private ski areas providing recreational facilities.

Manufacturing is almost non-existent in the basin except for repairs and local use.

There is no mining activity at the present time in the Plateau Creek Basin, although uranium, vanadium, bituminous coal and oil shale are known to underlie portions of it. Mining of these minerals has

developed elsewhere in Mesa County.

Figure 3 gives graphic illustration of how people earn their living in Mesa County compared to how people are employed statewide and nationwide.

Population Trend

A review of the population of the Plateau Creek subbasin for the past 30 years as summarized in Figure 4 and the following table shows the declining trend associated with agricultural based economies nearly everywhere in the United States.

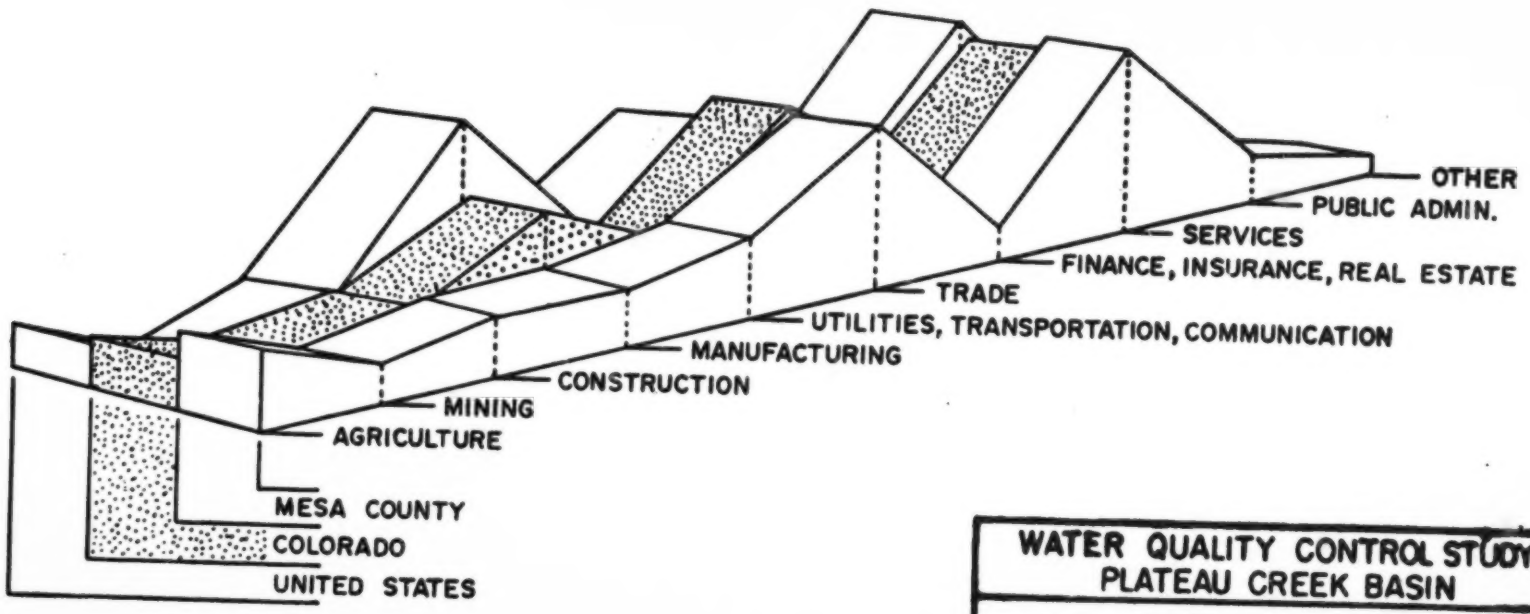
HISTORIC POPULATION TREND

	1930	1940	1950	1960	Percentage Change 1940-50	Percentage Change 1950-60
Plateau Creek Basin	2,115	2,017	1,540	1,569	-24	2
Town of Colibran	341	301	237	310	-21	30
Mesa County	25,908	33,791	38,974	50,715	15	30
City of Grand Junction	10,247	12,479	14,504	18,694	16	30
Colorado					18	32
United States					14	19

The increase in population in the decade of the 1950's occurred in the town of Collbran while the rural population continued to decline. In view of economic expectations for the area, it seems reasonable that the upward turn in the number of people in the area seen in the 1950-60 decade indicates the truer pattern for the future with perhaps an accelerated growth period of ten or twenty years. This growth will be largely in response to development of the areas adjoining the Plateau Creek Basin as discussed in the following section. Projections of the future population growth noted below anticipates some people living in the Basin and working outside at the sites of industrial development.

	1960	1980	2000	2030	2060
Plateau Creek (study area)	1,569	2,000	3,200	5,500	7,500
Mesa County	50,715	80,000	130,000	200,000	325,000

PERCENTAGE OF THE LABOR FORCE EMPLOYED BY INDUSTRY
COMPARISON OF MESA COUNTY WITH COLORADO
AND THE UNITED STATES

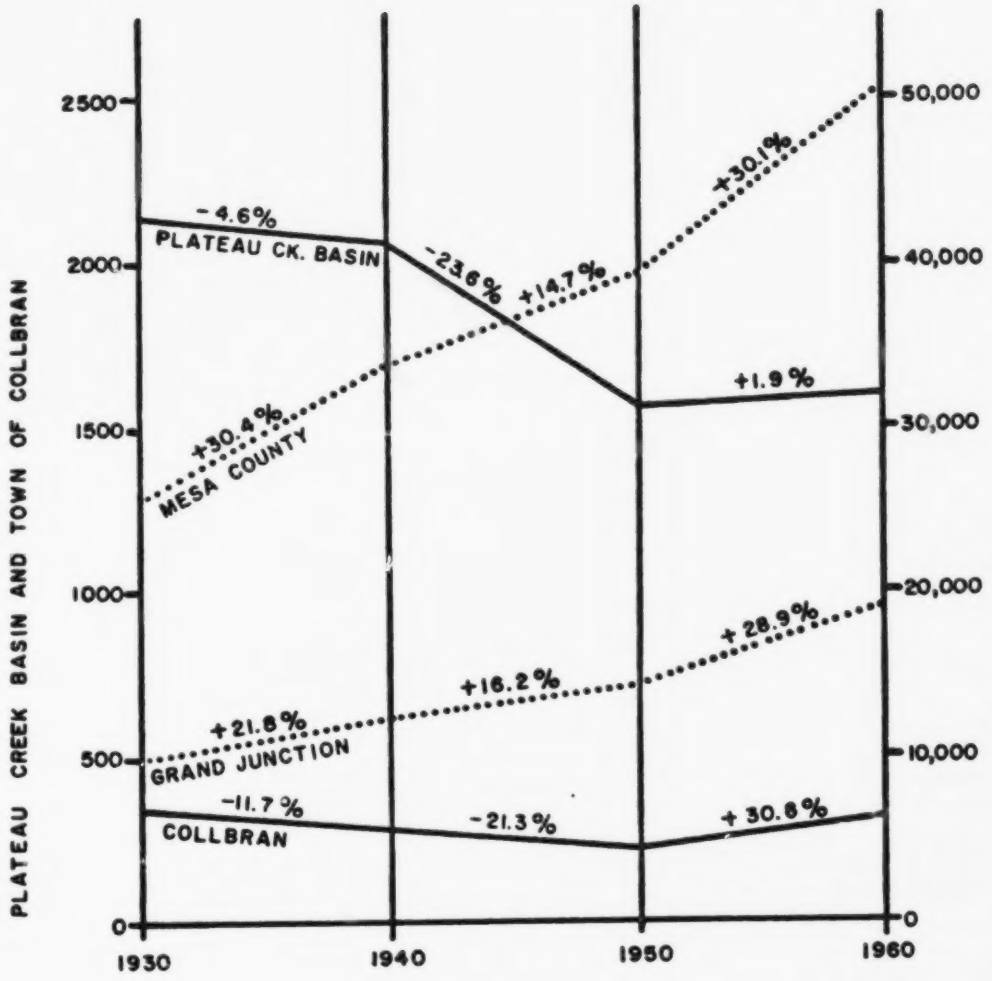


WATER QUALITY CONTROL STUDY
PLATEAU CREEK BASIN

EMPLOYMENT BY INDUSTRY

DEPT. OF HEALTH, EDUCATION & WELFARE
Public Health Service
REGION VIII DENVER COLO

FIGURE 3



WATER QUALITY CONTROL STUDY
PLATEAU CREEK BASIN

POPULATION TRENDS OF STUDY AREA AND AREA OF INFLUENCE

DEPT. OF HEALTH, EDUCATION & WELFARE
Public Health Service
REGION VIII DENVER, COLO.

FIGURE 4

Future Economic Activity

A discussion of the future prospects of the area must in large part be a discussion of potential developments outside the Plateau Creek Basin. Foremost of these is growth of the city of Grand Junction, which with a 1965 population of 22,000 people is the economic center of Mesa County and much of the western slope of Colorado. It is the trade and service center for western Colorado - a third of the labor force in Mesa County is in retail trade and services. The Grand Valley area surrounding Grand Junction, an important producer of fruit and vegetables, produces about 40 percent of the value of agricultural production of the western slope. Mineral production, particularly uranium, is also important with the Union Carbide Nuclear Co., Climax Uranium Co., and the U. S. Atomic Energy Commission, all maintaining facilities in the county. The population of Grand Junction and surrounding area has grown steadily in the past several decades and will likely continue to enjoy substantial growth based on its location and resources.

The Plateau Creek Basin is only 20 miles upstream along the Colorado River Basin from Grand Junction. Interstate Highway 70 and the Denver, Rio Grande, and Western Railroad, the two main transportation links through central Colorado pass right by the Basin. Thus the study area is in an excellent position to benefit from the growing population of the trade and transportation center at Grand Junction and the larger population of the Colorado eastern slope. It is well equipped to cater to the increasing recreational needs of these populations as well as providing dairy, livestock, and other agricultural products to them.

A second potential force in the growth of western Colorado which must be considered is development of a shale oil industry based on the vast quantities of oil shale in the area. The ultimate scale of such an industry and its rate of development is problematic. The most optimistic promoters of the industry envision a production rate of 1,000,000 barrels of oil a day to develop within 10 or 15 years, requiring an investment of 7.8 billion dollars. An industry of this size would mean an additional population of 350,000 people, which number would include a high ratio of support and service activities. This activity would center in the Colorado River Valley 15 to 30 miles upstream from the confluence of Plateau Creek. Such a development would of course greatly increase the demand for the products of the study area as outlined above. It would also introduce the possibility of residential subdivision development within Plateau Creek Basin. There is actually a pilot plant under construction at the present time that will begin operations sometime in 1966 and there has been experimental and research work going on for many years. Technological problems in the process remain to be solved. Demand and supply conditions in the oil industry and development of foreign and other liquid petroleum sources

as well as future Federal Government policies toward leasing of oil shale lands, much of which are in the public domain, will affect the economic feasibility of the industry. The projections of this study assume only a moderate, orderly development in this industry.

VI. WATER QUALITY CONTROL

Under provisions of the Federal Water Pollution Control Act, as amended (33 U.S.C. 466 et seq), in the survey or planning of a reservoir by any Federal agency, consideration must be given to the inclusion of storage for regulation of streamflow for the purpose of water quality control. It is expressly stated that any such storage shall not be provided as a substitute for adequate treatment or other methods of controlling wastes at their sources.

For the Battlement Mesa Project pollution of surface water will be limited to domestic waste and irrigation returns. There is no industrial waste source or any known mineral springs in the valley.

The towns of Collbran and Plateau City, along with the Bureau of Reclamation's Job Corps Camp are the only notable contributors of domestic waste in the basin. The Job Corps Camp is treating its waste in a lagoon which discharges into Plateau Creek. Municipal wastes from Collbran, population 320, and Plateau City, population 60, are presently being treated in individual septic tanks.

The domestic waste loading to Plateau Creek was considered on the basis of the population increasing to 2,200 persons by the year 2060 for the Plateau City-Collbran area. It was assumed that all domestic wastes discharging at that time into Plateau Creek would be treated so that 85 percent of the five day 20° C biochemical oxygen demand (BOD) would be removed prior to being discharged to Plateau Creek. Calculations show that to maintain a dissolved oxygen (DO) of 4 mg/l in Plateau Creek a flow of 3 cubic feet per second (cfs) must be maintained. This DO concentration is necessary to maintain rough fish and preserve a recreational environment.

The Colorado Fish and Game Department is not planning to recommend releases from Buzzard Creek Reservoir for the preservation of a fishing area in Plateau Creek. The maintenance of 5 mg/l DO for game fish was considered as being unnecessary since the local fish and game department is not recommending fish flows.

To determine the availability of the 3 cfs flow which is necessary to preserve existing fishery and recreational uses in the waste assimilation zone of Plateau Creek, two sources of dilution water were considered. These sources were the main stem of Plateau Creek above Collbran and Buzzard Creek below the proposed Colorado Canal heading. The Bureau of Reclamation believes the combined flows of both irrigation returns and ground-water accretions from both sources will provide the desired 3 cfs.

The effect of the proposed project upon the TDS concentration in surface streams was found by comparing the proposed project with the existing Collbran Project which is adjacent to the Battlement Mesa Project in the Plateau Creek watershed. The flow weighted mean TDS concentration of Plateau Creek at its mouth is 286 mg/l. However, under project conditions the concentrations will increase 31 mg/l. The flow weighted mean TDS of the Colorado River near confluence with Plateau Creek is 426 mg/l and TDS loads from the proposed project will increase this concentration by a calculated 0.5 mg/l.

Nearly all the irrigation lands are located such that any possible contamination of groundwater supply would not affect private wells. However, since Collbran takes its supply from infiltration wells on Buzzard Creek and since there will be irrigated lands above this point contributing leached dissolved solids to Buzzard Creek, a slight increase can be expected in TDS in the Collbran water supply. However, since Owens Reservoir will be releasing water, which is primarily good quality spring snowmelt, for storage in Buzzard Creek Reservoir, and since the Collbran water supply intake is between the two reservoirs, there will be a bettering of water quality for part of the year. The net effect of two changes in TDS is that no benefits or losses will result for Collbran's water supply.

This study has disclosed that under present and anticipated conditions there is no need for storage in the Battlement Mesa Project reservoirs for streamflow regulation for the purpose of water quality control. Both the present minimum streamflows and the anticipated return flows below this project will not impair the beneficial uses of Plateau Creek. This is not to preclude the possibility that a need for regulation of streamflow for the purpose of water quality control will become apparent when comprehensive studies of the Colorado River Basin have been completed. These studies should establish the magnitude of the cumulative effect on water quality of the many projects being planned and constructed by the Bureau of Reclamation and others, or the possible cumulative improvement in the quality of the Colorado River which might be derived from the integrated operation of storage provided for flow regulation in all of these reservoirs. Until such studies have provided more definitive data, however, recommendations cannot be made.

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PART B

PUBLIC HEALTH ASPECTS

I. SUMMARY AND RECOMMENDATIONS

Summary

1. Project development will improve the economy and permit the establishment of a more healthful environment.

2. Recreational development contiguous to reservoirs will be partially regulated by the topographical features of the shoreline.

3. Temporary construction camps will be necessary to serve the contractor's employees.

4. As overall watershed management involves many interests, it is essential that the effect on public health be fully coordinated with state and/or local health departments.

5. Mosquitoes are the principal vectors which might be affected by the proposed project, although other insects and rodents may be involved.

6. Provision for the prevention and control of man-made vector sources will increase the overall benefits of the project.

Recommendations

Overall watershed management requires the cooperation of many interests to assure that development and activities will minimize the potential public health hazards associated with the proposed project. It is recommended that the following be given due consideration in development of the Battlement Mesa Project:

1. That the water users' organization (i.e., Water Conservancy District) operating as the general administrative and contracting agency for the project should:

   a. Alert all water users of the potential public health hazards associated with using inadequately treated water for culinary purposes;

   b. Exert all possible precaution to exclude inadequately treated sewage and barnyard drainage from project canals, laterals, and drains;

   c. Wherever and whenever possible, assist the project inhabitants and communities in development of approved water and sewerage facilities; and

d. Operate and maintain project facilities in accordance with established criteria.

2. That potential recreational areas be investigated and at least minimum water and sanitary facilities be provided in accordance with Colorado State Department of Health regulations.

3. That a sanitary survey of proposed construction campsites be made and all camps be provided with water and sanitary facilities in accordance with Colorado State Department of Health regulations.

4. That recreational activities, at reservoirs utilized as a source of public water supplies, meet the requirements established by the Colorado State Department of Health.

5. That person or persons responsible for a public water supply establish suitable controls over the use of watershed areas tributary to the supply to insure production of raw water meeting the quality requirements established by the Colorado State Department of Health.

6. As public health safeguards against vector-borne diseases, every possible effort should be made during the planning, construction, and operational phases of the proposed project to avoid creating conditions which will increase populations of mosquitoes and other arthropods and rodents of public health importance or increase the likelihood of exposure of humans to such vectors. It is therefore recommended that:

   a. Where applicable, the principles and practices for prevention and control of vector problems associated with reservoirs outlined in Appendix B be adhered to in the design, construction, and operation of the proposed project.

   b. Where applicable, the principles and practices for prevention and elimination of mosquito sources associated with irrigation outlined in Appendix C be adhered to in the development, operation, and maintenance of the project.

II. PUBLIC HEALTH AND RELATED PROBLEMS

Public Health Services

Project development will improve the economy of the area so that local residents benefiting either directly or indirectly will be in a position to enjoy a higher standard of living. Among other necessities, this involves the establishment of a healthful environment. Some of the more important factors in creating such an environment include the development of safe and ample culinary water supplies, proper waste disposal facilities, and insect and rodent control measures.

Recreational Development

Concomitant with the development of water resources comes the increased use of lands adjoining reservoirs for recreational purposes. This presents major problems of sanitation involving those of coordination of the multiple use policy and prevention of water pollution. The extent of recreational development, planned or spontaneous, immediately contiguous to reservoirs will be partially regulated by the topographical features of the shoreline. Also, a receding shoreline during the irrigation season, together with an accumulation of mud deposits above the water level, will create hazardous and undesirable conditions for some water-based recreational activities.

Construction Phase of Project

No housing accommodations are available in the vicinity of the construction site to serve the contractor's employees during the construction phase of the project. Under these conditions a temporary construction camp will be necessary. Prior to selection of a campsite a sanitary survey of the proposed area should be made by the State Department of Health or the Public Health Service to assist in solving of problems which may be encountered in connection with the installation of water and sanitary facilities.

Water supplies and sanitary facilities required in connection with temporary construction camps and with permanent housing for reservoir attendants should comply with the requirements of the Colorado State Department of Health so as to eliminate potential health hazards.

Sanitary Aspects of Watershed Management

As overall watershed management involves many interests, it is considered essential that proposed developments and activities on

watersheds pertaining to public health aspects be fully coordinated with state and/or local health departments. These matters should be mutually considered prior to the actual development of the watershed and issuance of permits.

Adequate and safe water and sanitary waste disposal facilities, in accordance with state and/or local health agency standards, should be provided in public use areas to serve camping, picnicking, and other recreational uses. Water and sanitary facilities for private dwelling sites should also meet the established health standards. The effectiveness of the sanitation program should be evaluated periodically by a detailed sanitary survey in conjunction with laboratory analyses of water samples collected from surface and/or groundwater in the watershed.

Preliminary Vector Evaluation

Anticipated Effects of the Proposed Project on Vector Problems

The mosquito survey in Mesa County in 1959 showed that mosquito production occurred throughout the irrigated sections. Of the 99,000 acres of irrigated lands, over 3,000 were found to be producing mosquitoes. Almost two-thirds of the mosquito breeding was found in water-filled surface depressions on irrigated fields, wasteland, pastures, and along the flood plain of the Colorado River and its tributaries. Other mosquito-producing lands included marshes, sloughs and oxbows, trunk drains and natural washes, ponds, borrow pits, field irrigation and drain ditches, and seeps. Water in the mosquito-producing habitats came primarily from seepage from higher irrigated land, plus seepage from canals and ditches; from residual irrigation water; and irrigation waste water.

Culex tarsalis, the common encephalitis mosquito, comprised approximately 62 percent of the mosquitoes taken in the 1959 survey, and was common in most of the areas surveyed from the middle of June through early September. The vicious-biting Aedes dorsalis and Aedes vexans ranked second and third, respectively, in mosquitoes collected.

On the basis of the survey findings in 1959, it is anticipated that increased irrigation activities in the area of the proposed project will result in corresponding increases in mosquito production unless appropriate preventive measures are incorporated into the design, construction, and maintenance of the project.

Conditions favorable for the production of mosquitoes would be expected to occur in the upper reaches of the proposed reservoirs and in protected embayments if flat or gently-sloping vegetated areas are

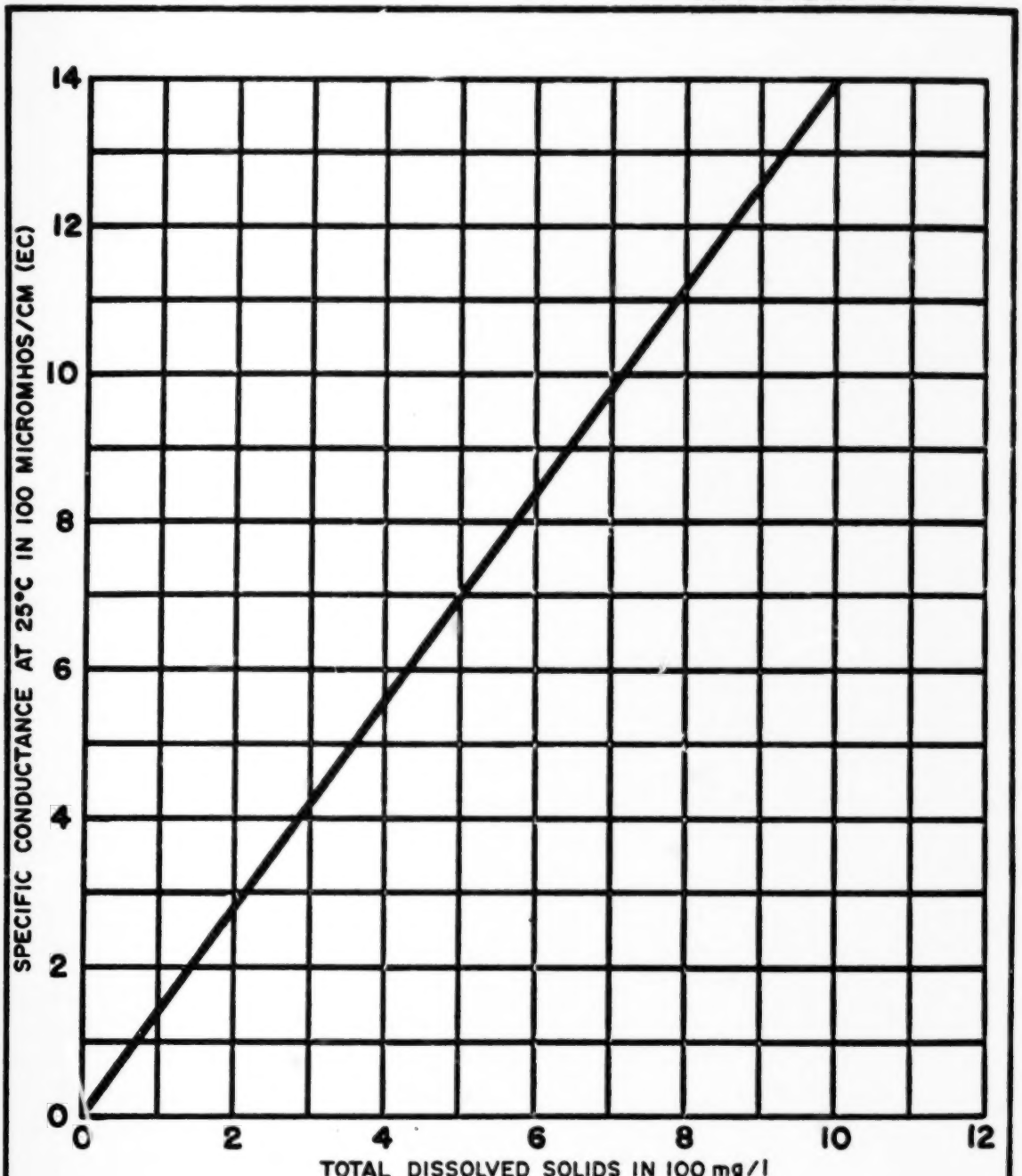
shallowly inundated for extended periods during the summer or if marginal depressions are intermittently flooded as a result of fluctuating water levels. Conditions associated with the reservoirs which are favorable for the production of mosquitoes could be prevented or minimized by proper clearing of the basins, selective shoreline conditioning, and installation of adequate drainage facilities.

Development of recreational and other public use areas in conjunction with the proposed reservoirs may result in exposure of humans to vectors of terrestrial origin including arthropods such as ticks, fleas, flies, and rodents such as ground squirrels, chipmunks, and mice. To minimize public health hazards at waterside recreational areas, appropriate prevention and control measures for both aquatic and terrestrial vectors should be carried out.

Responsibility for Vector Control

Responsibility for vector prevention and control is normally associated with land ownership or operating rights. Therefore, the agency, group, or individuals responsible for various aspects of the proposed project should be prepared to accept full responsibility for the prevention and control of vector problems resulting from the design, construction, operation, or maintenance of the project.

APPENDICES



WATER QUALITY CONTROL STUDY
PLATEAU CREEK BASIN

SPECIFIC CONDUCTANCE VERSES TOTAL DISSOLVED SOLIDS FOR WATERS IN BATTLEMENT MESA AREA

DEPT. OF HEALTH, EDUCATION & WELFARE
Public Health Service
REGION VIII DENVER, COLO

APPENDIX B

Principles and Practices for Prevention and Control of Vector Problems Associated with Reservoirs

I. Prevention and Source Reduction Measures

A. For Mosquitoes and Other Aquatic Insects

1. All borrow pits and other potential ponding areas associated with construction of the dam, relocation of highways or roads, etc., which are located above maximum pool level should be made self-draining.

2. Prior to impoundage, the reservoir basins should be prepared as follows:

   a. The normal summer fluctuation zone of the permanent pool should be completely cleared except for isolated trees and sparse vegetation along abrupt shorelines which will be exposed to wave action.

   b. Dense stands of timber rooted below the normal summer minimum pool level but extending above that elevation should be cleared. In some situations, such timber may be felled and securely tied down in lieu of disposal.

   c. Borrow pits, depressions, marshes, and sloughs which will be flooded by the reservoir at maximum pool level and which would retain water at lower pool levels should be provided with drains to insure complete drainage or fluctuation of water within them.

   d. If the summer fluctuation zone of the permanent pool is limited to a few feet, consideration should be given to "building out" mosquito-producing areas located within flight range of population groups or recreational areas through the use of measures such as deepening and/or filling. This would minimize the need for repetitive measures for controlling vegetation and mosquito production.

3. After impoundage, the following maintenance measures should be carried out in all potential mosquito-producing areas located within flight range of human population groups or recreational areas frequented by significant numbers of persons:

   a. All dense vegetation should be removed periodically from flat, protected areas within the normal summer fluctuation zone of the permanent pool.

b. Vegetation, debris, and flotage should be removed periodically from all drains to insure free flows.

4. Water level management to minimize conditions favorable for mosquito production should be used to the maximum degree permitted by the primary purposes of the reservoir. This will minimize the need for repetitive measures for controlling vegetation and mosquito production.

5. As a general principle, waterside recreational areas, particularly those which have facilities for overnight human occupancy, should be located along sections of the reservoir which have a low production potential for mosquitoes and other aquatic insects of public health importance.

B. For Terrestrial Arthropods and Rodents at Recreational Areas

1. Proper storage, collection, and disposal of refuse should be practiced in order to prevent and control flies, wasps, other noxious insects, rats, wild rodents, and other small mammals.

2. All buildings should be rodentproofed at recreational areas where rodents are prevalent which may create public health hazards.

3. Debris, rubbish, and other materials which may serve as harborage for rodents and other small mammals should be removed periodically.

4. Brush and weeds along paths, trails, roadways, and other areas of frequent use by visitors should be removed in order to reduce the likelihood of tick infestation.

II. Supplemental Chemical Control Measures

In situations where adequate vector control is not obtained through prevention and source reduction measures, provision should be made for supplemental use of insecticides and rodenticides to achieve the desired level of control.

III. Vector Appraisal

Arrangements should be made for carrying out a routine program of vector appraisal as a part of normal operations of the reservoir and associated recreational areas. Inspections for adult and larval mosquitoes and other vectors are essential for planning and evaluating control measures and for adjusting control programs to meet temporary or emergency situations.

APPENDIX C

Principles and Practices for Prevention and Elimination of Mosquito Sources Associated with Irrigation

A. Project Conveyance and Distribution Systems

1. Lining or other satisfactory seepage control measures should be provided for all sections of canals and laterals located in porous material where excessive leakage would result in waterlogged areas, seeps, and ponds.

2. Drains should be installed to prevent ponding of excess irrigation water and natural runoff along the upper side of canals and laterals. All drainage crossing or inlet structures should be placed on grade to avoid ponding.

3. Borrow areas should be self-draining to keep them from retaining ponded water.

4. Where possible, provision should be made to prevent turnouts and other hydraulic structures from retaining residual water when they are not being used.

5. Effective measures should be provided to prevent ponding of leakage from water control structures.

6. Every effort should be made to establish delivery schedules which will provide farmers with adequate but not excessive amounts of water at proper intervals to insure efficient irrigation of the crops concerned.

7. Vegetation and debris which would retard normal flows should be periodically removed from conveyance channels, water control structures, and drains.

B. Project Drainage Systems

1. Trunk drainage systems should be installed to insure complete removal and proper disposal of excess irrigation water, natural runoff, and seepage from both irrigable and nonirrigable lands affected by the distribution and use of irrigation water on the project.

2. Drainage ditches should be designed, constructed, and maintained so as to minimize ponding in the channels and to insure free flows at all times.